INSTRUCTION MANUAL
TUNING UNIT, 150 KC to 30 MC
MODEL T-A/NF-105
SERIAL NO.

EMPIRE DEVICES PRODUCTS CORP.
BAYSIDE 61, NEW YORK

Freq ±10%

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1. General

Tuning Unit T-A/NF-105 covers the frequency range from 150 KC to 30 MC by means of six bands.

Its calibration method differs from T-1/NF-105 and T-2/NF-105, the 20-400 MC ranges, in that, in addition to the peak c libration, the carrier calibration also is performed by means of the impulse noise generator.

The procedure for peak calibration is identical to that used for the 20-1000 MC ranges,and is described in detail in the instruction manual for the NF-105. Carrier (CW) calibration is performed by means of the impulse generator. This procedure is possible since both the level of the impulse generator and the bandwidth of the receiver are known. The bandwidth of the receiver must be considered because the impulse noise sensitivity of the receiver is a function of the receiver bandwidth. If, for instance, the receiver had a bandwidth of one megacycle, its CW sensitivity in microvolts would equal its impulse sensitivity expressed in microvolts per megacycle bandwidth. If the receiver bandwidth were only 0.1 megacycle, the impulse noise c librating voltage required for the previous CW sensitivity adjustment of the receiver, would have to be increased by a factor of 10. Calibration chart (Figure 1) indicates the equivalent impulse level required to produce a full scale delection of 100 microvolts of carrier (CW) voltage.

The noise bandwidth of Tuning Unit Model T-A/NF-105 is approximately 10 KC. The exact value of bandwidth (in megacycles) for any frequency may be determined by referring to the alibration chart shown in Figure 1 and dividing the carrier sensitivity (100 uv) by the equivalent impulse level.

For example: $\frac{100 \text{ uv}}{80 \text{ DBMC}} - \frac{100 \text{ uv}}{10{,}000 \text{ uv}} = 0.01 \text{ MC} = 10 \text{ KC}$

2. Accessories

The following are the components of Antenna Equipment Model LM-105:

Carrying Case	LC-105
Loop Antenna	LP-105
Vertical Antenna	VA-105
Magnetic Probe	LO-105
Line Probe (50 ohms)	LA-105
Line Probe (500 ohms)	LF-105

The input impedance of the NF-105 for all frequency ranges is 50 ohms. In order to achieve efficient energy transfer from the vertical and the loop antennas, couplers (impedance matching devices) are furnished as part of these antennas. Since the impedance of the antennas is a function of frequency, matching transformers are used for each frequency range of Tuning Unit T-A/NF-105.

The vertical antenna VA-105 consists of a 41" collapsible rod mounted on top of its coupler. The coupler contains six autotransformers, whose 50 ohm output, by means of a six position switch, is connected to the antenna receptacle located on the coupler.

Similarly, the loop antenna LP-105 is mounted on a coupler containing the appropriate matching networks. They are also selected for the proper frequency range by means of a six position switch.

Magnetic Field Probe Model LO-105 is similar to Magnetic Field Probe Model MP-105 except that it has more inductance than the latter so as to provide effective low frequency pickup. Since Model LO-105 and MP-105 are of the same physical appearance Magnetic Field Probe Modal LO-105 has half its loop painted red to provide a simple means of identification .

Line Probes Model LA-105 and LF-105 are designed for 50 ohms and 500 ohms impedance respectively. They are used in the same manner as Line Probes LL-105 and LH-105, as described in the instruction manual for the higher frequencies.

3. Conducted Measurements (Two Terminal VTVM)

Connect the impulse generator output to the signal input receptable (located on the Basic Measuring Unit) by means of the 18" cable. In addition, connect the attenuator output to the corresponding receptacle on the tuning unit by means of the 6" cable. Connect the signal input receptacle to the equipment to be measured as shown in Figure 2.

Turn the equipment on and after it has warmed up, adjust the meter balance and zero adjust controls for meter zero. Turn the impulse generator on and adjust its pulse repetition rate to approximately 1000 cycles per second.

For CW measurement adjust the Impulse Generator output controls to the value indicated for the desired frequency (see Figure 1).

Set the signal input attenuator to 20 DB. Turn the bandswitch on the tuning unit to the proper frequency range and tune to the desired frequency. Turn the function switch to its peak setting and adjust the gain control for full scale indication on the large meter.

The instrument now has a full scale sensitivity of 100 microvolts (CW as a two-terminal vacuum tube voltmeter. By changing the attenuator setting 0, 40, 60 or 80 DB the sensitivity is changed to 10, 1,000, 10,000 or 100,000 microvolts full scale, respectively. Calibration by means of the impulse noise signal must at all times be made with the function switch in the PEAK position, even though the instrument is being calibrated to be used for carrier measurements.

After the calibration has been performed carrier measurements are normally taken with the function switch in the CARRIER position. Readings must be taken in the PEAK position, however, if the peak value of a modulated carrier is to be measured.

If sensitivity in excess of that produced by the above described calibration procedure is desired, the sensitivity may be increased by 20 DB as follows: Set signal input attenuator to 40 DB instead of 20 DB while calibrating. This procedure increases the full scale sensitivity of the instrument to 1, 10, 100, 1,000, and 10,000 microvolts respectively depending upon the setting of the signal input attenuator. Therefore, when following this alternate calibration procedure, deduct 20 DB from the indicated reading. In the one microvolt full scale position, correction for residual noise may be applied as indicated in the instruction manual for the NF 105.

For PEAK measurements of broadband noise the substitution method (visual or aural) is used as described in detail in the instruction manual for the NF-105. The readings of broadband noise are always in terms of DB above 1 microvolt per megacycle bandwidth.

4. Radiated Measurements

In order to make radiated measurements, vertical antenna Model VA-105 or loop antenna Model LP-105 are used as pick-up devices. If measurements are conducted in a shielded room, vertical antenna Model VA-105 is commonly employed. Extend the vertical antenna to its full length (41 inches). The base of the coupler must be mounted on a metal plate about 12" square (not furnished), which is bonded to the metal bench top by means of a copper bond strap 12" wide. A typical set-up is shown in Figure 3.

Connect the impulse generator output to the signal input receptacle (located on the Basic Measuring Unit) by means of the 18" cable. In addition, connect the attenuator output to the corresponding receptacle on the tuning unit by means of the 6" cable.

Turn the equipment on and after it has warmed up, adjust the meter balance and meter zero control. Turn the impulse generator on and adjust its pulse repetition rate to approximately 1000 cycles per second.

For CW measurements proceed as follows:
Adjust the impulse generator output controls to the value indicated for the desired frequency (see Figure 1).

Set the signal input attenuator to 40 DB. Turn the bandswitch on the tuning unit to the proper frequency range and tune to the desired frequency. Turn the function switch to its peak setting and adjust the gain control for full scale indication on the large meter.

Disconnect the 18" cable from the signal input receptacle and in its place connect the pick-up device (VA-105) by means of the 30 ft. cable. Set the bandswitch of the coupler to the desired frequency range.

Check by means of the tuning adjustment on the tuning unit that the desired signal produces maximum meter deflection. It may be necessary to change the input attenuator setting in order to achieve on "on scale" meter reading. If in tuning to the signal to be measured an appreciable departure from the original calibrating frequency was required, consult the calibration chart (Figure 1) and, if necessary, calibrate at the new frequency. Add to the sum of the meter and signal input attenuator readings (in DB) the antenna factor of Figure 4. The reading thus obtained in DB above one microvolt constitutes the antenna induced voltage.

For measurement of broadband noise the substitution method (visual or aural) is used as described in the instruction manual for the NF-105. The readings of broadband noise are always in terms of DB above one microvolt per megacycle bandwidth. Add to the result of the substitution measurement the antenna factor in Figure 4, plus a constant of 20 DB.

If for either CW or broadband noise measurements the loop antenna (LP-105) is to be employed, refer to Figure 5 for the proper antenna factor wherever Figure 4 is mentioned above.

For measurement of field strength in microvolts per meter refer to the next section.

5. Field strength measurements may be conducted be means of either the loop or the vertical antenna. Results obtained when using the loop antenna will be more accurate since they are essentially independent of ground consistency and height above ground. On the other hand a disadvantage of the loop antenna, especially at the lower frequencies, is its small effective height compared to that of the vertical antenna. For these

reasons, use the loop antenna for field strength measurements whenever the signal level is sufficient to produce an adequate indication. Since the loop antenna is a directive device, it must be rotated for maximum pickup as indicated by the meter.

If a low signal level makes the use of the vertical antenna necessary, it is recommended that the antenna be located over the center of a network of wires placed on the ground and covering an area of approximately 800 square feet. The base of the antenna coupler must be connected to the ground network by a side bonding strap.

In spite of the precaution of spreading a ground wire network it is recommended that for greater accuracy, the vertical antenna be calibrated by means of the loop antenna at or near the frequency to be measured.

The calibration procedure is the same as that described in the previous section on radiated measurements. In order to obtain field strength in DB above one microvolt per meter, refer to Figure 4 for the vertical antenna and Figure 5 for the loop antenna. Add 6 DB (the effective height of a 41" rod) to the readings obtained using Figure 4.

6. Circuit Description

The frequency range of 0.150 MC to 30 MC is divided into six turret switched bands using IF frequencies of 0.455 and 1.600 MC. The proper intermediate frequency is chosen automatically by the bandswitching turret.

BAND	FREQUENCY	IF
1	0.150 to 0.360 MC	0.455 MC
2	0.360 to 0.870 MC	1.600 MC
3	0.870 to 2.1 MC	0.455 MC
4	2.1 to 5.2 MC	1.600 MC
5	5.2 to 12.5 MC	1.600 MC
6	12.5 to 30 MC	1.600 MC

The input signal, after passing through the signal input attenuator in the Basic Measuring Unit, is applied to a tuned circuit preceding an RF Amplifier, using a type 5702 pentode. The signal is then fed to the tuned mixer stage employing a 5875 tube where it is mixed with the local oscillator voltage. The local oscillator employs a 5702 and operates above the signal frequency by an amount equal to the IF frequency. The resulting IF signal is amplified by the corresponding IF amplifier. Each IF amplifier consists of 4 double tubed stages using 6BJ6 tubes. A schematic diagram of Tuning Unit T-A/NF-105 is shown in Figure 6.

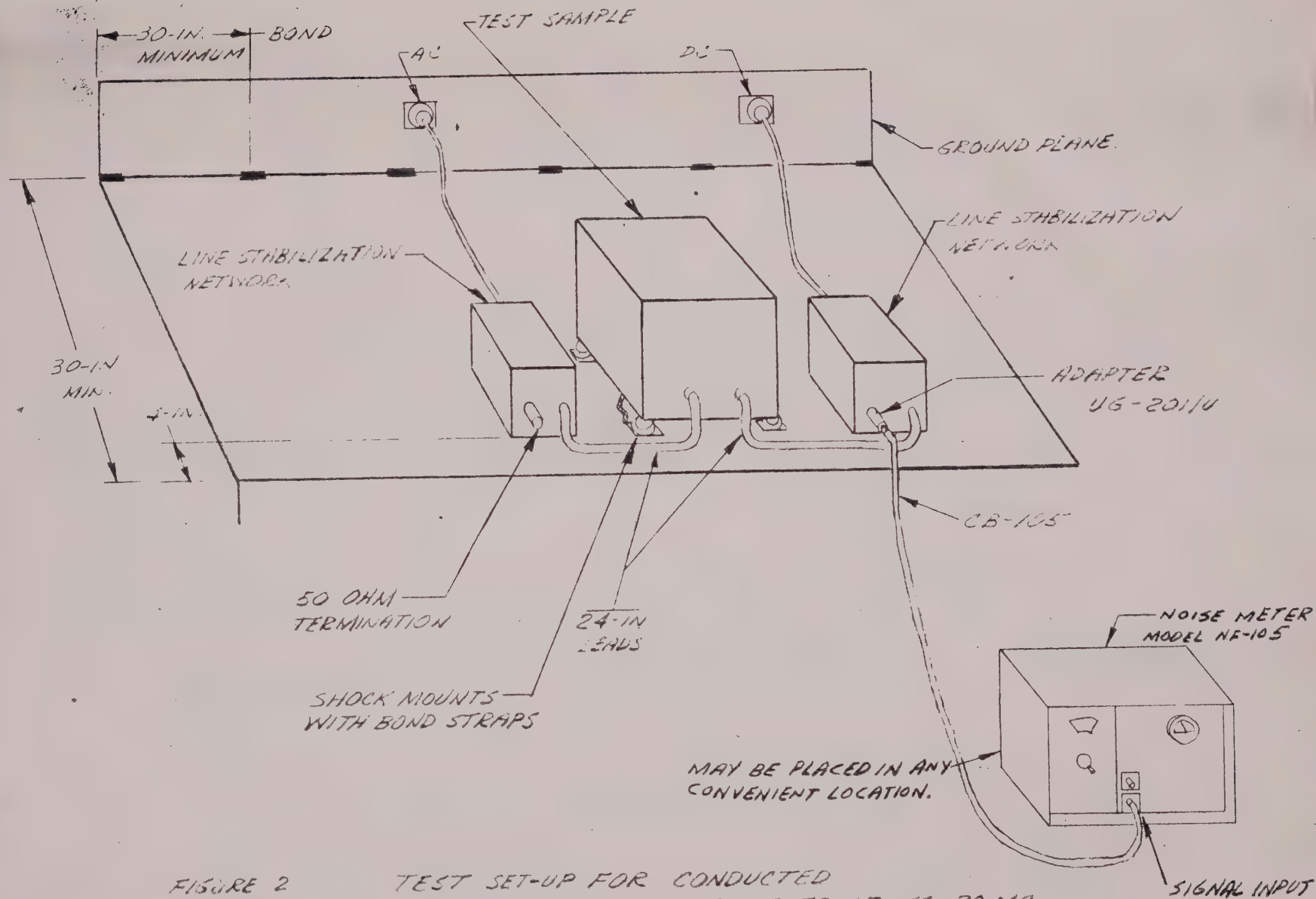

FIGURE 2 TEST SET-UP FOR CONDUCTED INTERFERENCE MEASUREMENTS 150KC-30MC

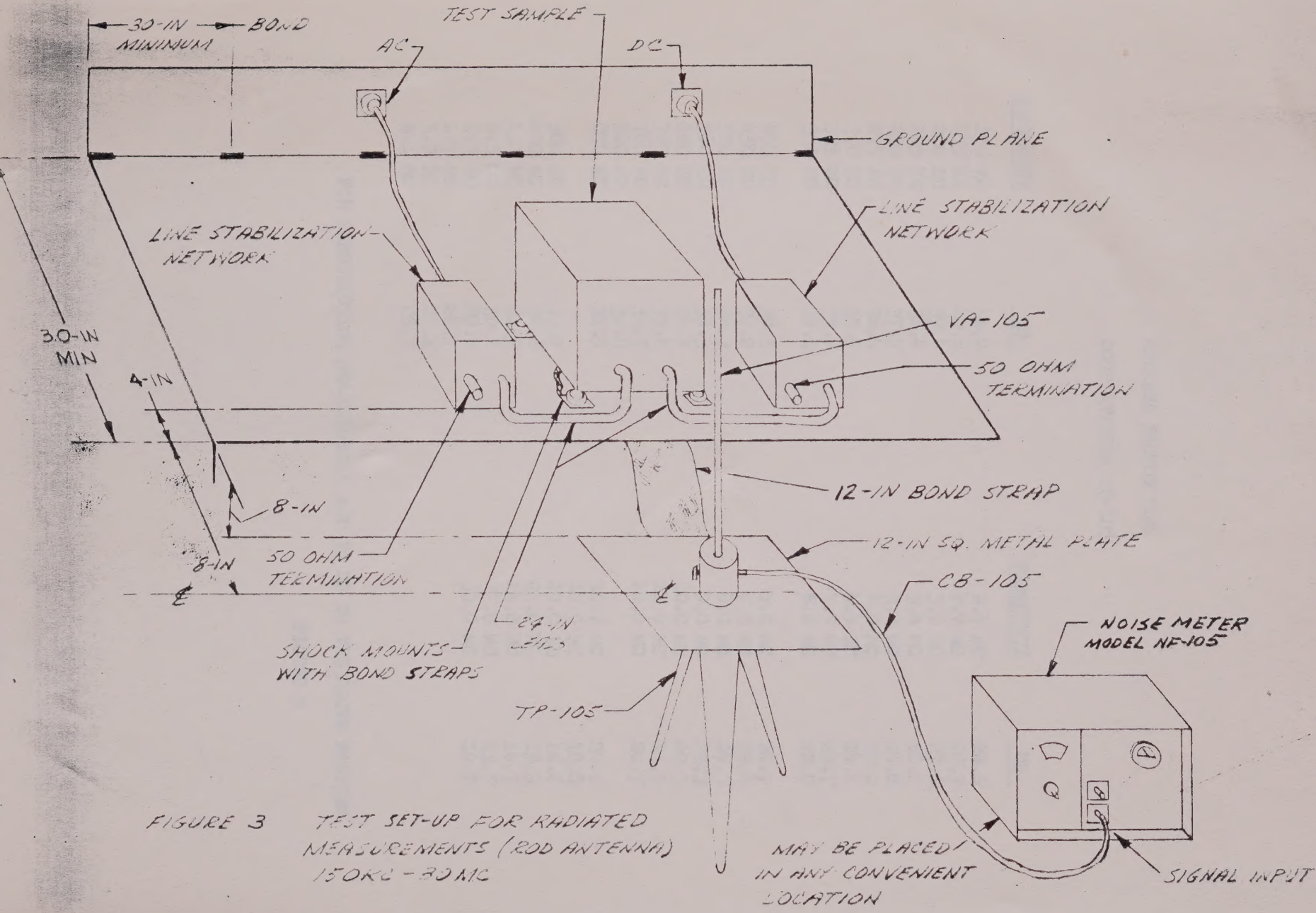

FIGURE 3 TEST SET-UP FOR RADIATED MEASUREMENTS (ROD ANTENNA) 150KC - 30 MC

ANTENNA FACTOR FOR

LOOP ANTENNA LP-105

FREQUENCY	DB	FREQUENCY	DB
150 KC	41.9	2.4 MC	29.6
175 KC	40.6	2.7 MC	28.7
200 KC	39.4	3.0 MC	27.6
225 KC	38.4	3.4 MC	26.6
250 KC	37.5	3.7 MC	25.8
275 KC	36.6	4.0 MC	25.2
300 KC	35.9	4.4 MC	24.4
325 KC	35.2	4.7 MC	23.7
360 KC	34.3	5.2 MC	22.9
400 KC	38.3	6.0 MC	26.7
450 KC	37.2	7.0 MC	25.4
500 KC	36.3	8.0 MC	24.3
560 KC	35.3	9.0 MC	23.3
620 KC	34.4	10.0 MC	22.3
700 KC	33.4	11.0 MC	21.5
760 KC	32.7	12.0 MC	20.7
820 KC	32.0		
870 KC	31.5	12.7 MC	20.2
		15.0 MC	18.8
900 KC	33.7	19.0 MC	16.8
1000 KC	32.8	21.0 MC	15.9
1.1 MC	31.9	24.0 MC	14.7
1.3 MC	30.5	27.0 MC	13.7
1.5 MC	29.3	30.0 MC	12.7
1.7 MC	28.1		
1.9 MC	27.2		
2.1 MC	26.3		

FOR SUBSTITUTION MEASUREMENTS ADD 20 DB TO THE ABOVE FACTORS

FIGURE 5